

Carter Testimony for hearing titles “From Lab to Market: A review of NSF Innovation Corps,” on Wednesday, December 5<sup>th</sup>, 2017 at 10 am

**Summary:** My name is Sue Carter and I have been a 3-time participant in the NSF I-Corps program and currently run an NSF I-Corps site at the University of California, Santa Cruz. In addition, I am a Physics professor who has transitioned basic research out of the lab into start-up companies three times. Consequently, I can provide my experience with NSF I-Corps as a student and teacher of the curriculum, and as a faculty member and entrepreneur who has started companies both before and after going through the NSF I-Corps program.

In my view, the NSF I-Corps program’s strength is that it pushes researchers out of the lab and into the community to talk to potential customers, enabling them to better understand the value, or lack thereof, that their research has on these customers. For me, this insight has resulted in doing more impactful applied research with less time and money because I can focus my research in areas that can positively impact the lives of US citizens. Similarly as an entrepreneur, the NSF I-Corps program has resulted me in spending substantially less time and money to get a product to market.

**Experience at Start-ups before and after taking NSF I-Corps:** Let me provide a few examples. I have been a principle at four start-up companies, Add-vision, an organic LED company, Solexant, a photovoltaic company, Soliculture, an advanced greenhouse company, and IRIS, a science academy. The first two companies are before I had I-Corps training and the last two are after I went through I-Corps training.

At Add-vision, we raised over \$6 million in funding, mostly from our strategic partners but we also had some support from DOE and NSF SBIR program. We used this funding to develop a printable organic LED (shown in Figure 1) that could be used in a wide variety of back-light and signage applications and which could meet the commercial specs given to us by our partner. However, we never fully identified a customer for this product and ended up selling our company to Sumitomo, a Japanese Company. If I had had the experience of the NSF I-Corps program, I believe we could have identified customers much early on and grown Add-vision into a US-based company that could have been a leader in organic LED technology, employing hundreds of people in the US.

At Solexant, we raised over \$30 million dollars, mostly in Venture capital and a few SBIR grants. This funding was focused on developing the thin film PV technology (see Figure 2) and building a thin film PV manufacturing line in the Oregon. However, yet again we failed to identify a customer and value proposition



Figure 1: Add-vision’s fully printed OLED technology. Sold to Sumitomo in 2011.

for the product that was developed which ultimately led to the manufacturing facility never being built. After burning through much of the initial multimillion dollar investment, that company was taken over by new management who understood that the value that we provided to our customers was the low cost highly efficient manufacturing process that made solar cells, rather than the solar cells themselves. Siva Power recently raised new investment to scale their manufacturing process and are poised to become a leading supplier of thin film solar cells. If we had had the experience of the NSF

I-Corps program, I'm confident we would have not blown through the \$30 million dollars on a fruitless path towards manufacturing a product that our customer wasn't interested in but would have instead focused it on a R&D direction on a product with considerably more customer demand, greatly accelerating product launch and helping to assure US dominance in manufacturing processes for thin film solar cells. While Siva Power may still grow to the leading thin film PV provider, generating thousands of jobs, we have lost valuable market share to China with in the intervening time.

The two companies I started after NSF I-Corps resulted in us being able to sell a commercial product to customers with much less time and funding, namely less than \$2 million in the case of Soliculture and less than \$10,000 in the case of IRIS. This efficiency directly resulted from our many conversations with potential customers, and key partners, that the NSF I-Corps program largely forced us to do. While it's too early to know how many jobs Soliculture will generate, its pathway to selling commercial product was many years faster than the two previous companies that work in similar commercial space. Needless to say, I'm convinced that the small cost of the NSF I-Corps training pays for itself many times over by reducing start-up time-to-market. For start-ups that receive funding through the SBIR/STTR program, this also saves US tax payer money as it allows the principle investigators to use the funding much more efficiently to develop a technology that someone is willing to pay for.

**NSF I-Corps Curriculum at UCSC:** Given my positive experience as a faculty member in the NSF I-Corps program, I decided to offer the NSF I-Corps curriculum to students at my university through a summer entrepreneurship academy, which uses a hybrid on-line/in person approach very similar to the NSF I-Corps national curriculum. We use Launchpad Central which greatly decreases the time we need to prepare material, saves the students funding on textbooks, and allows us to provide regular feedback to the students. While only a few of the students going through the program actually start companies, the training has proven invaluable to students as they seek employment after the graduate. Students have come back to tell me that this is the most valuable course they took at UCSC and that they received their job



Figure 2: Solexant's printable thin film PV technology. Solexant reemerged as Siva Power to focus on thin film PV manufacturing process and tools.

offer because they had taken the I-Corps course. Understanding how to listen to your customers and make changes to a product so that it fulfills their needs is important in almost any job, but it's something that academia is very bad at teaching students as we find ourselves sometimes stuck in an the echo chamber of a university.

**Future Directions:** I want to conclude with how the program could move forward to better benefit students. For student entrepreneurs who want to move their company forward, and even for some who don't, it's very helpful for them to know how to approach to and talk to VCs and other investors. They also need to understand the legal contexts behind their start-up. This training is not currently in the NSF I-Corps curriculum but would be easy to add and in doing so create a universal course that could be used to accelerate US innovation by supporting early training of our entrepreneurs. The other major issue is that the training is largely limited to students, faculty and their mentors. This is very limiting as many of the entrepreneurs who could most benefit from the program do not fall into these categories. Even recently graduated students who are ready for I-Corps can't participate as they have already graduated. So, I'd like to see the program open up to other entrepreneurs, many of whom are likely to be willing to pay to take the course. I know I would have been. Some of our top young entrepreneurs receive funding through the SBIR/STTR program so that may be an excellent vehicle to expand the offering.